at least one of the images and a measured local temperature value to calculate an AF step code, and calculate a focal length variation based on a reference AF step code. The focal length variation may be used with the binocular disparity to calculate the depth of the object. The reference AF step code may be calculated separately based on images captured by the image apparatus in association with a measured reference local temperature value. At least the reference AF step code may be stored in a memory of the image apparatus, and the image apparatus may access the stored reference AF step code to calculate the focal length variation based on the calculated AF step code associated with the current local temperature value.

[0064] FIG. **9** is a block diagram of an image sensor **100** according to some example embodiments of the inventive concepts. The image sensor **100** may include the image sensor **10**. The image sensor **100** may be included in an image apparatus **1**. As illustrated, the image sensor **100** may include a pixel array **110**, a control unit **125**, a row decoder **133**, a row driver **135**, a column decoder **153**, a column driver **155**, and a plurality of analog-digital converters (ADCs) **171**, **173**, and **175**.

[0065] The pixel array **110** may sense incident light reflected from an object to generate object information OBI1 associated with the object and/or image information IMI associated with the object. Such information may include images captured ("generated") by one or more pixels of the pixel array **110**. The pixel array **110** may include a plurality of pixels arranged in a two-dimensional matrix. The pixel array **110** may include a plurality of pixel layers **111**, **113**, and **115**. In some example embodiments, the pixel array **110** includes three pixel layers **111**, **113**, and **115**, although the pixel array **110**, in some inventive concepts, is not limited to three pixel layers.

[0066] In some example embodiments, the first pixel array **111** may be a color pixel array. For example, the color pixel array may include Bayer-pattern pixels.

[0067] In some example embodiments, the second pixel array **113** may be a depth pixel array. For example, the depth pixel array may include a plurality of 2PD pixels or metal shield pixels. In some example embodiments, the second pixel array **113** may include at least one temperature sensor TS to perform depth correction depending on temperature.

[0068] In some example embodiments, the third pixel array **115** may be a thermal pixel array. For example, the thermal pixel array may include a plurality of temperature pixels.

[0069] The pixel array **110** may be configured to include at least two pixel arrays to perform different functions.

[0070] The control unit **125** may generate control signal(s) to control operations of the row decoder **133**, the row decoder **135**, the column decoder **153**, the column driver **155**, and the analog-digital converts (ADCs) **171**, **173**, and **175**. For example, the control unit **125** may generate a plurality of row control signals to select a specific one of the row lines that are included in the stacked pixel layers **111**, **113**, and **115**, respectively.

[0071] The row decoder **113** may decode a plurality of row control signals, e.g., row address signals output from the control unit **125** and output a plurality of row selection signals according to a decoding result. In response to the row selection signals output from the row decoder **133**, the row driver **135** may drive pixels included in at least one of the rows that are included in the pixel layers **111**, **113**, and **115**, respectively.

[0072] The column decoder **153** may decode a plurality of column control signals, e.g., column address signals output from the control unit **125** and output a plurality of column selection signals according to a decoding result. In response to the column selection signals output from the column decoder **153**, the column driver **155** may drive a plurality of column lines that are included in the pixels layers **111**, **113**, and **115**, respectively.

[0073] For brevity of description, it is shown that the image sensor **100** includes one row driver **135** and one column driver **155**. However, in some example embodiments, the image sensor **100** may include a plurality of row driver or column drivers to drive a plurality of row lines or column lines. The image sensor **100** may include a plurality of row decoders or column decoders.

[0074] Each of the analog-digital converters (ADCs) **171**, **173**, and **175** may analog-to-digitally convert signals output from the pixel arrays **111**, **113**, and **115** and output the analog-to-digitally converted signals to an image signal processor (ISP) **200** as image data. For example, image data may include object information OBI1 and/or image information IMI.

[0075] In some example embodiments, each of the analog-digital converters (ADCs) **171**, **173**, and **175** may further include a correlated double sampling (CDS) circuit to perform correlated double sampling on signals that are output from the pixel layers **11**, **113**, and **115**, respectively. Each of the analog-digital converters (ADCs) **171**, **173**, and **175** may compare a correlated-double-sampled signal with a lamp signal and output a comparison result as image data.

[0076] The image signal processor (ISP) **200** disposed outside the image sensor **100** processes and displays the image data. As described in FIGS. **1** to **8**, the image sensor **100** may be configured to correct depth according to local temperature values measured by a temperature sensor TS.

[0077] Example embodiments of inventive concepts may be applied to a data processing system.

[0078] FIG. **10** is a block diagram of a handheld terminal **1000** according to some example embodiments of the inventive concepts. As illustrated, the handheld terminal **1000** includes an image apparatus **1100**, a wireless transceiving unit **1200**, an audio processing unit **1300**, an image file generation unit **1400**, a nonvolatile memory device **1500**, a user interface **1600**, and a controller **1700**.

[0079] The image apparatus **110** may include the image apparatus **1**. The image apparatus **1100** includes a lens **1110**, an image sensor **1120**, an image single processor **1130**, and a display unit **1140**. In some example embodiments, the image sensor **1120** may include a pixel array to measure depth described in FIGS. **1** to **8**. The image apparatus **1100** may include at least one temperature sensor TS that is disposed at a portion of the lens **1110**, outside the lens **1110** or inside the image sensor **1120** and measures temperature.

[0080] The image signal processor **1130** may include a temperature focal length variation table F(T). The image apparatus **1100** may use the temperature focal length variation table F(T) to correct a determined depth of an object relative to the image apparatus **1** depending on temperature of the lens **1110** and ambient temperature around the lens **1110**, as described with reference to FIGS. **1** to **8**. In FIG. **10**, the temperature focal length variation table F(T) is stored in